

Characterization and Trend Analysis of the  
Prevalence of Lift Assist Calls at South King Fire & Rescue (2006-2014)

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**Abstract**

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This thesis study expanded upon a 2010 South King Fire & Rescue (SKF&R) department study measuring the impact of lift assist calls on the department's total call load. Lift assist calls are 911 calls made when an individual, who is usually older and/or physically or medically disabled, requires emergency medical service (EMS) assistance getting up from the sitting or laying position due to a fall or general weakness. The 2010 study measured an increasing prevalence of lift assist calls between 2006 and 2010. This thesis study supported the trends observed in the 2010 study and also measured a continued increase in the proportion of lift assist calls after 2010 followed by a slight stabilization through 2014. Additionally, this study observed that the number of patients requesting lift assists on an annual basis more than doubled across the study period, increasing from 152 callers in 2006 to 322 callers in 2014. As with the 2010 study, this study also concluded that the majority of lift assist calls were requested by individuals who requested more than one lift assist a year. Between 2006 and 2014, the percentage of lift assists requested by repeat callers increased from 54.12% to 66.61%. Furthermore, the majority of lift assist calls originated from private residences as opposed to nursing homes, such as adult family homes, assisted living facilities, and adult independent living facilities. Additional research may

be required to continue to monitor the trend in lift assist calls made to this department. These trends may be due to the increasing population of older adults moving into the SKF&R area of responsibility. Future interventions may consider targeting repeat lift assist callers to minimize the proportion of lift assist calls made per year.

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## Introduction

South King Fire & Rescue (SKF&R), located in King County, Washington, serves an area of nearly 41 square miles and more than 150,000 residents (South King Fire & Rescue). The SKF&R “first-due”, or the primary area of responsibility served by the department, consists of the entire city of Federal Way and parts of neighboring Auburn and Des Moines. SKF&R provides fire and emergency medical services, as well as public assistance, to residents. In recent years, in addition to its total call load, the department has anecdotally reported a persistent increase in the proportion of lift assist calls. This study explored the impact of lift assist calls on the department’s call load.

Lift assist calls may occur for a multitude of reasons. Commonly resulting from falls, lift assists are characterized as emergency medical service (EMS) calls requiring emergency responders to physically lift patients who are usually uninjured and may otherwise be unable to raise themselves. This inability to lift oneself may be due to weakness associated with pre-existing medical conditions such as multiple sclerosis, amputations, diabetic neuropathy, and/or obesity. Lift assist requests generally affect older populations who are more susceptible to weakness. Despite the prevalence of these types of calls, little research has been conducted to measure the impacts of lift assists on EMS operations.

With the lack of lift assist literature available, an exploration of fall calls can provide some context to the implication of lift assist calls on emergency services. Between 2007 and 2011, approximately 45.49% of all nonfatal injury hospitalizations in King County resulted from a fall (Washington State Department of Health, 2013). These data included hospitalizations resulting from 911 calls, emergency room visits, and other inpatient services. During this time period, falls were the most frequently reported cause of nonfatal unintentional injury hospitalization for all age groups (Washington State Department of Health, 2013). As a

substantial proportion of nonfatal injury hospitalizations, fall-related care equates to a tremendous strain and usage of social service, hospital, and emergency resources. Even if a patient does not incur an injury during their fall, their initial fall increases the risk of the patient falling again (Fuller, 2000). Other factors increasing the risk of a patient falling include increasing age, acute illness, use of multiple medications, and chronic conditions, such as diabetes (Fuller, 2000). Furthermore, patients requiring help with daily activities due to limitations in mobility are 14 times more likely to report having two or more falls over a twelve month period (Institute of Medicine (U.S.) Division of Health Promotion and Disease Prevention, 1992). These factors all contribute to general patient weakness, which may result in the patient requiring a lift assist due to, or independent of, a fall.

As lift assist calls continue to rise, SKFR will experience two notable impacts on operations: increased out-of-service time and increased time loss injuries. Firefighters (FFs) are out-of-service when they are actively on a call, leaving them unavailable to attend other incoming calls. Increasing out-of-service time decreases time available to respond to other non-acute or acute calls. Time loss injuries are work-sustained injuries requiring a FF to take time off of work. The National Fire Protection Association (NFPA) reported 63,350 FF injuries in 2014 (Haynes & Molis, 2015). 55.3% of these injuries were reported as muscle strains, sprains, or pain (Haynes & Molis, 2015). While musculoskeletal injuries result from a variety of causes, many lower back musculoskeletal injuries occur due to back injuries (National Institutes of Standards and Technology, 2005).

FF back injuries are the cumulative result of repetitive lifting. Every time a FF lifts an object, such as a patient or heavy equipment, the risk of the FF sustaining a back injury increases (Collopy, Kivlehan, & Snyder, 2014). In 2011, the Centers for Disease Control and Prevention

(CDC) reported more than 27,000 injuries sustained by EMS workers, 21% of which occurred to the lower back (Centers for Disease Control and Prevention, 2014). The National Institute for Occupational Safety and Health (NIOSH) has set forth guidelines in efforts to protect FF and other healthcare providers; NIOSH established a 51-pound weight limit for lifts conducted by single-workers (Waters, 2007). Despite this guideline, FFs must routinely lift patients weighing much larger than the recommended limit in order to complete the lift assist calls at-hand. Furthermore, in addition to pain and suffering of the individual FF, time loss injuries cost the department time, money, and manpower. Injured FFs may have to work administrative positions until complete recovery, resulting in a smaller workforce with which to respond to emergencies (Collopy, Kivlehan, & Snyder, 2014). FF employers must also provide compensation payments, as well as possible overtime, while backfilling injured FF positions with other staff (Collopy, Kivlehan, & Snyder, 2014).

The impact of lift assist calls on SKF&R resources was first explored in a 2010 department study, which measured a steadily increasing percentage of lift assist calls out of all EMS calls from 2.5% to 7.2% during the 2006 to 2010 study period (Plumlee, 2010). The majority of these calls originated out of private homes as opposed to nursing homes<sup>1</sup>. The study also showed that 23% of lift assist callers dialed 911 for assistance more than once in a year; these repeat callers accounted for 54% of all lift assist calls. Furthermore, the study reported increasing total out-of-service time resulting from lift assist calls from 86 hours in 2006 to 250 hours in 2010 (Plumlee, 2010). The study determined that out of 149 department injury claims filed during the study period, 29 resulted from lifting patients. 11 of the 29 lift injuries resulted from lift assist calls, specifically.

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<sup>1</sup> For the purpose of this report, “nursing homes” encompasses facilities such as adult family homes, assisted living facilities, and adult independent living facilities.

A 2013 study of another EMS department found similar conclusions (Cone, Ahern, Lee, Baker, Murphy, & Bogucki, 2013). Researchers determined that, over a five-year period, 32.5% of patients dialing 911 for a lift assist calls accounted for 66.8% of all lift assist calls served by the department. Furthermore, 77.5% of patients calling 911 for a lift assist on more than one occasion did so within 30 days after the first lift assist. Researchers concluded that these calls are associated with substantial subsequent utilization of EMS for a range of problems (i.e., lift assists, falls, injuries, and medical complaints). Researchers further hypothesized that lift assist calls may be early indicators of medical problems requiring early intervention or more aggressive evaluation.

In 2014, SKF&R received an Efficiency and Effectiveness (E&E) grant from Public Health – Seattle King County (PHSKC) to fund an analyst to expand a department-wide falls prevention program. This program consisted primarily of a referral component, which implemented a new intervention to train FFs to refer fall patients to the PHSKC One-Step-Ahead program. Although lift assist calls do not consist of fall calls, alone, decreasing falls could result in fewer lift assist calls. However, upon program implementation in 2015, SKF&R had not re-investigated the impact of lift assist calls on their call load since the 2010 study.

This thesis study explored the impact of lift assist calls on the SKF&R call load. This study included an analysis of lift assist calls from 2006 to the end of 2014 by conducting a priori analytical methods. Data analysis was derived out of call data collected in the SKF&R FireRMS database. This study investigated the variability of lift assist calls by exploring the following research questions: (1) had the percentage of lift assist calls at SKF&R increased over the study period?; (2) how much time were SKF&R FFs spending on lift assist calls?; (3) how many lift

assist calls originated from repeat versus one-time callers?; and (4) how many lift assist calls occurred in private housing versus nursing homes?

## Methods

This study measured the impact of lift assist calls on SKF&R response over a nine-year period. All data was extracted retroactively from the SKF&R FireRMS database. The FireRMS database tracks every SKF&R 911 call and stores each call as a separate record (with the exception of fire-related exposure calls, which do not apply to this study). Records are automatically created as soon as a dispatcher accepts a 911 call and activates the dispatch to the SKF&R department; during the course of the 911 call, the record is pre-populated with descriptive call characteristics including call time, dispatch time, incident type, and dispatch narrative (see Figure 1).

Figure 1. FireRMS Incident Form

The screenshot shows the FireRMS Incident Form for incident 1600099-000. The form is organized into several sections:

- Header:** Incident Number 1600099, Exposure 000, Alarm: 17:59:06, Arrival: 18:02:59, Cleared: 18:52:46.
- Response Section:** Alarm Time (01/02/2016 17:57:32), Arrival Time (01/02/2016 18:02:59), Controlled Time (01/02/2016 18:05:11), Cleared Time (01/02/2016 18:52:46). Includes Incident Delay, No Arrival checkbox, and Response Time = 0:03:53.
- Incident Section:** Incident Type (A. Incident Type Field), Priority (checked), EMS Provided (checked), CO (unchecked), Alt. Form (unchecked), Arson (unchecked). Includes Casualties (No), Alarms, Shift (A), and First Due (64).
- Primary Action Taken Section:** (B. Primary Action Taken Field).
- Hazardous Materials Released Section:**
- Other Sections:** Auto/Mutual Aid Given/Received (None), Other Depts., Incident No., State, Critical Incident, Team Mobilized, Circumstances, Detector, Initial Dispatch Code (7R3), and Incident Reported By.

The “incident type” code (see field A in Figure 1) indicates the basic type of call to which FFs will be responding (e.g., medical, fire, public service, etc.); each call record can only have one “incident type” code. The dispatch narrative consists of phrases detailing the conversation between the reporting party and the dispatcher. Responding FFs manually complete the remainder of each call upon returning to the fire station. Additional information includes actions taken, patient information, and an additional narrative, if necessary. The “primary actions taken” code (see field B in Figure 1) indicates the steps FFs took to resolve the incident on-scene (e.g., provided medical treatment, patient lift, transported patient to local hospital, etc.). Call records may have more than one “actions taken” code because FFs may have had to take several actions to complete a call. The second narrative supplements the dispatch narrative by providing more details of the patient, response, and any other information that the FF deems important to record. Completed records are then subject to approval up the chain of command.

The study population consisted of all EMS and Public Service 911 calls made from residential addresses located in the SKF&R geographic first-due between 2006 and the end of 2014. These calls were extracted from the FireRMS database using MyFireRules (MFR) pivot tables. Any mutual aid responses provided by SKF&R in neighboring fire districts were excluded as these calls did not originate within the SKF&R first-due. Furthermore, mutual aid responses received by SKF&R from neighboring fire departments were included in this study because these calls fell within the geographic area of responsibility of the department

Once calls were sorted by geographic first-due, the next step was to extract all lift assist calls out of the database. FireRMS does not have an “incident type” code specifically for lift assists. As such, lift assist calls had to be pulled from a larger list of calls labeled with more general “incident type” codes. EMS and Public Service calls using the following “incident type” codes

were included:

- 311 (assist medical care)
- 3110 (no injury)
- 3111 (patient assist)
- 510 (person in distress, other)
- 553 (public service)
- 554 (assist physically disabled)
- 550 (public service other)

These “incident type” codes include all codes historically used by SKF&R FFs to denote lift assist calls.

Call records meeting the inclusion criteria thus far then had to be sorted as lift assist calls or non-lift assist calls. This sorting was conducted by a thorough review of call record dispatch narratives, secondary narratives, and “actions taken” codes. Although no specific “actions taken” codes were pre-selected for identifying lift assist calls, the following “actions taken” codes indicated that the call may have resulted in a lift assist:

- 30 (emergency medical services, other)
- 31 (provide medical aid)
- 311 (check for injuries or illness)
- 329 (cancelled at scene)
- 34 (transport person)
- 70 (assistance, other)
- 71 (assist physically disabled)
- 711 (patient lift)
- 73 (provide manpower)

“Actions taken” codes were then cross-referenced with dispatch and FF narratives to deduce whether the call was a true lift assist. Manual examination of the call records was required for several reasons. First, database entry procedures for lift assist calls had not been standardized until after the 2010 department study. As such, lift assist calls were not labeled consistently and could not be extracted simply via pivot tables. Second, FireRMS consists of

entries submitted by all FFs at SKF&R. Methods and justification for classifying each call may differ between FFs. The best way to ensure whether a call was a true lift assist was to search each call's dispatch narrative, FF narrative, and patient information.

Call record classification methods were determined and standardized prior to sorting through the remaining records. Inclusion criteria for lift assist calls included the following characteristics: patient or reporting party requested lift assist; patient or reporting party indicated they had fallen and/or were too weak to get up on their own or with the assistance of other individuals located on-scene; patient or reporting party requested assistance from a seated/prone position to a standing/seated position; patient or reporting party requested assistance from one piece of furniture to another; patient or reporting party requested assistance carrying a patient to or out of a vehicle; and/or private ambulance companies requested additional SKF&R assistance and resources returning a bariatric or otherwise immobile patient to their home. Since any lift assist call puts a FF at the risk of sustaining a lower back injury, any call that held the potential for a FF to lift a patient was considered a lift assist call. Lift assist calls canceled upon arrival were included because this study intended to measure the proportion of lift assist 911 calls. Furthermore, even though no lifting was conducted, canceled calls still require SKF&R time and resources as the vehicle is out-of-service when it is driving to a canceled call.

Many 911 calls exhibited characteristics similar to that of a lift assist call but were not included in this study. Exclusion criteria from lift assist calls included the following characteristics: patient or reporting party requested a wheelchair push; patient or reporting party requested wheelchair repair; and patient or reporting party requested assistance with household chores. Calls that did not risk the possibility of a patient lift, while otherwise resource consuming, were not included in this study. Non-lift assist calls were excluded from the study.

Following the lift assist call sorting, lift assist calls were divided by year of call date to identify repeat callers. Calls originating from the same address (which included house number, street name, and unit number) were considered as possibly originating from the same callers. Calls originating from the same address were further explored to differentiate between different family members (e.g., husbands, wives, children, parents, etc.). Other identifiable patient information, such as patient name, age, and/or gender, was then used to differentiate between patients. Repeat callers were only identified within each calendar year and not identified over the entire duration of the study period because, given the absence of data, it became impossible to accurately track the same patient over all nine years of data.

Next, each lift assist was identified as originating from a private home versus a nursing home. Additionally, the mean and total out-of-service times per year, as well as over the study period, were calculated using this final data set. Patient residence and out-of-service time was included as part of each recorded call data. After data sorting and labeling was complete, the dataset was analyzed to answer the following questions: (1) Annually, what percentage of EMS/Public Service calls is for lift assist calls?; (2) In total, from 2006-2014, what percentage of EMS/Public Service calls is for lift assist calls?; (3) Annually, what is the average out-of-service time for lift assist calls?; (4) Annually, what is the total number out-of-service time hours due to lift assist calls?; (5) Annually, how many patients called 911 for lift assists?; (6) Annually, what percentage of patients requested more than one lift assist?; (7) Annually, what percentage of lift assist calls occurred in private homes?; and (8) In total, from 2006-2014, what percentage of lift assist calls occurred in private homes?

Percentages of lift assist calls were calculated for each year of the study period, in addition to the total percentage of lift assist calls for the entire study period. Mean and standard

deviation out-of-service time for lift assist calls was calculated for each year, as well as the total study period. Top and lower quartiles were also calculated for out-of-service time for each year. Once the aforementioned analysis was complete, logistic regression was performed on the proportion lift assist calls with the categorical variable, year, as the dependent variable, and the proportion of lift assist calls as the outcome variable. P-Values less than 0.05 were considered statistically significant.

## Results

SKF&R received 110,718 EMS/Public Service calls during the study period. Of these calls, 4,516 (4.08%) were for lift assists. During the first year of the study period, SKF&R responded to 11,984 EMS/Public Service calls, 255 (2.13%) of which were for lift assists. A summary of lift assist call frequency can be found in Table 1. Graphs depicting the number of lift assist calls, total EMS/Public Service calls, and proportion of lift assist calls can be found in Figures 2 and 3. Note that Figure 2 consists of two lines depicting the frequency of lift assist calls, as well as total EMS/Public Service calls; both lines correspond with different Y-axes. The blue line depicts the frequency of lift assist calls and corresponds with the left Y-axis. The red line depicts the frequency of total EMS/Public Service calls and corresponds with the right Y-axis. Figure 3 depicts the percentage of lift assist calls out of the total EMS/Public Service calls.

Table 1. Frequency of lift assist calls between 2006 – 2014.

	2006	2007	2008	2009	2010	2011	2012	2013	2014	Total
Number of lift assist calls	255	274	374	534	641	698	562	540	638	4516
Total number of EMS/Public Service calls	11984	11733	12489	11826	11701	11906	12429	12821	13829	110718
Percentage of EMS/Public Service calls that are lift assist calls	2.13	2.34*	2.99*	4.52*	5.48	5.86*	4.52	4.21	4.61	4.08

\* = indicates a statistically significant change ( $p < 0.05$ ) in proportion of lift assist call as compared to the previous year

Figure 2. Frequency of lift assist and total EMS/Public Service calls by year.

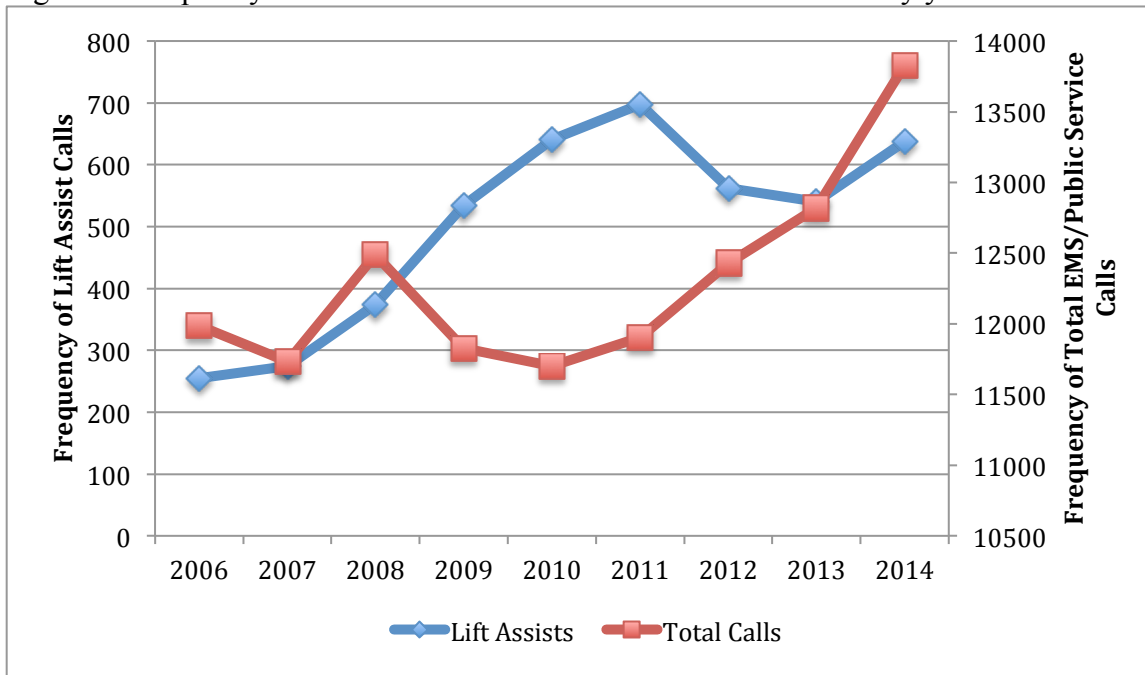
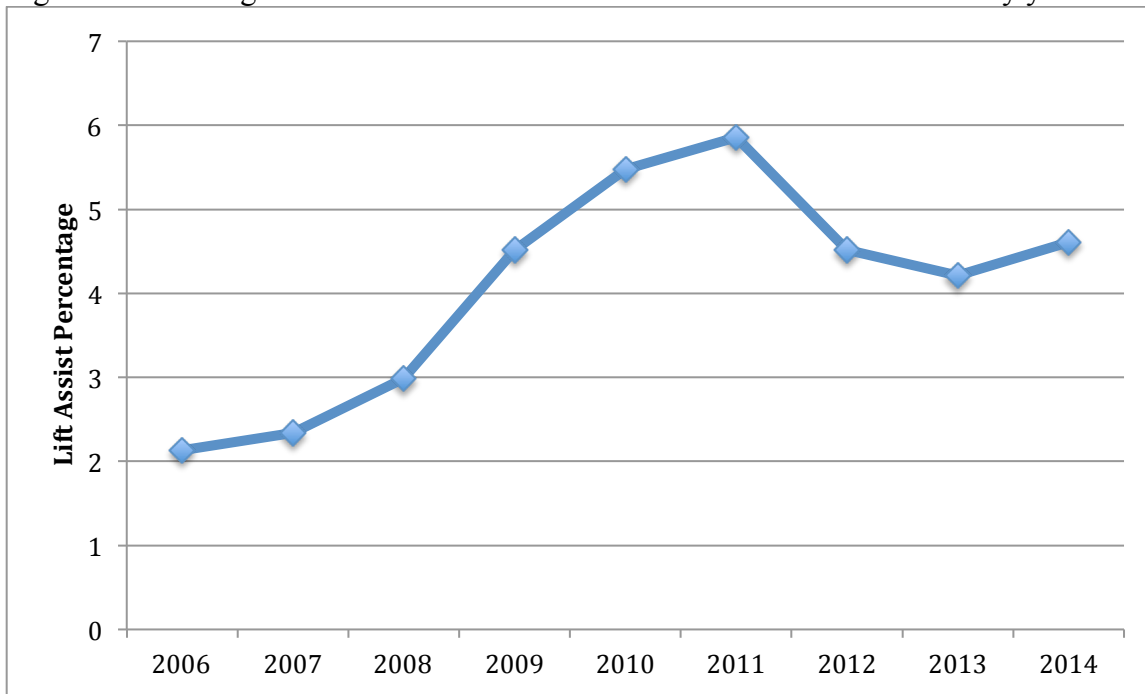


Figure 3. Percentage of lift assist calls out of total EMS/Public Service calls by year.



These data show a steadily increasing percentage of lift assist calls from 2006 to 2011 with a slight decrease in 2012 and 2013. The percentage of lift assist calls increases, again, in 2014. The highest percentage of lift assist calls occurred in 2011 (5.86%), with the lowest occurring in 2006

(2.13%). Although only half of the calculated percentages reflect statistically significant changes in value between year, these values coincide with years of increased percentage.

A summary of caller frequency can be found in Table 2. In 2006, SKF&R received 255 calls requesting a lift assist; however, SKF&R only received lift assist calls from 152 callers, indicating that a proportion of callers dialed 911 for a lift assist more than once that year. Roughly 77% of callers requested a lift assist only once that year, 16.4% of callers requested a lift assist two to four times that year, and one patient requested a lift assist more than 11 times. Similarly, in 2014, only 66% of callers requested a single lift assist that year. The percentage of one time callers appears to be decreasing over time, with more patients requesting two to four lift assists per year over the study period. On average, one-time callers made up 71.5% of all callers requesting a lift assist. Despite making up the majority of lift assist callers, one-time callers requested fewer calls, overall, than repeat callers. The final row of Table 2 displays the percentage of annual lift assist calls made by repeat callers, which appears to have increased over the study period.

Table 2. Frequency of lift assist callers between 2006 – 2014.

	2006	2007	2008	2009	2010	2011	2012	2013	2014	Total
Number of lift assist calls	255	274	374	534	641	698	562	540	638	4516
Number of callers	152	174	230	282	309	358	314	291	322	---
Number of 1 time callers (% of callers)	117 (77.0)	137 (78.7)	163 (70.9)	197 (69.9)	223 (72.2)	248 (69.3)	217 (69.1)	204 (70.1)	213 (66.1)	---
Number of repeat callers (% of callers)	35 (23.0)	37 (21.3)	67 (29.1)	85 (30.1)	86 (27.8)	110 (30.7)	97 (30.9)	87 (29.9)	109 (33.9)	
Breakdown of repeat callers:										
Number of 2-4 time callers (% of callers)	25 (16.4)	31 (17.8)	56 (24.3)	65 (23.0)	61 (19.7)	92 (25.7)	80 (25.5)	74 (25.4)	89 (27.6)	---
Number of 5-7 time callers (% of callers)	7 (4.6)	2 (1.1)	9 (3.9)	9 (3.2)	12 (3.9)	11 (3.1)	9 (2.9)	8 (2.7)	10 (3.1)	---
Number of 8-10 time callers (% of callers)	2 (1.3)	1 (0.5)	2 (0.9)	6 (2.1)	4 (1.3)	2 (0.6)	5 (1.6)	2 (0.7)	4 (1.2)	---
Number of 11+ time callers (% of callers)	1 (0.7)	3 (1.7)	0 (0)	5 (1.8)	9 (2.9)	5 (1.4)	3 (1.0)	3 (1.0)	6 (1.9)	---

Percentage of calls requested by repeat callers	54.12	50.00	56.42	63.11	65.21	64.47	61.39	62.22	66.61	---
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In addition to lift assist calls, these data show an increase in the number of lift assist callers. In 2006, data show 152 lift assist callers, but this number increased 211.8% to 322 lift assist callers in 2014. Figure 4 consists of nine graphs depicting the percentage of lift assists requested by one-time and repeat callers over each year in the study period. Each graph consists of two columns made of two colors: red corresponds to callers requesting more than one lift assist that year, while blue corresponds to callers requesting only one lift assist that year. The left columns of each graph depict the percentage of one-time and repeat lift assist callers per year, while the right columns depict the percentage of lift assist calls requested by one-time and repeat lift assist callers. These graphs depict the final row of Table 2 and show repeat lift assist callers request more than half of all lift assist calls made each year, as presented by the red portion of the right column.

Figure 4. Percentage of calls made by one-time and repeat callers by year (figure continues on following page).

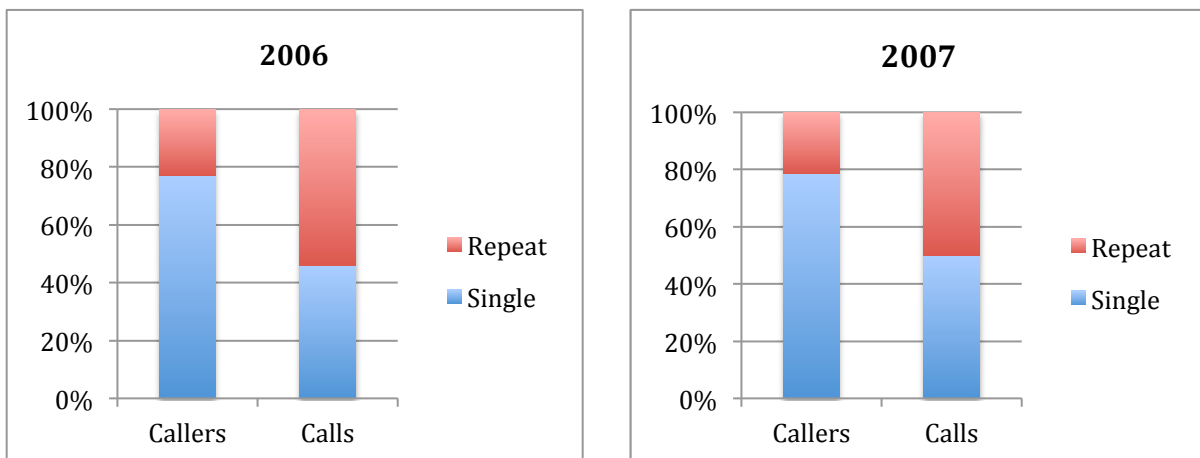


Figure 4 (continued). Percentage of calls made by one-time and repeat callers by year (figure continues on following page).

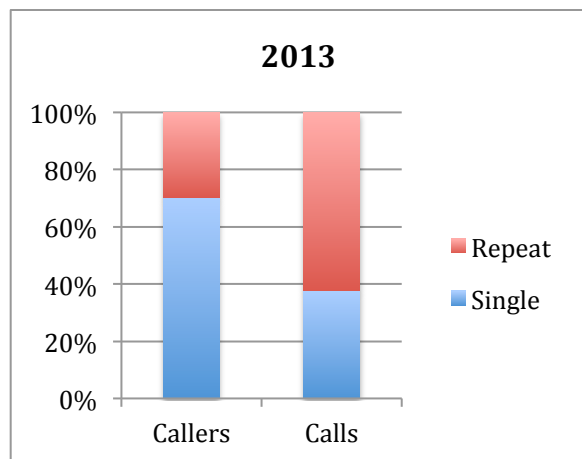
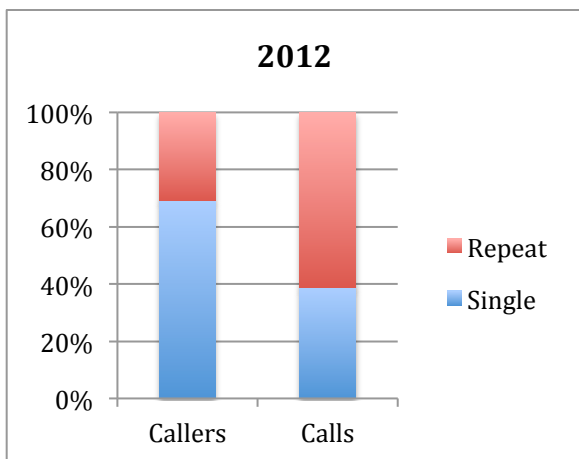
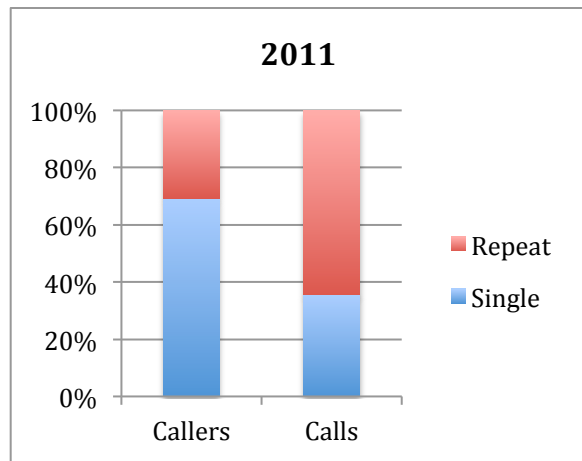
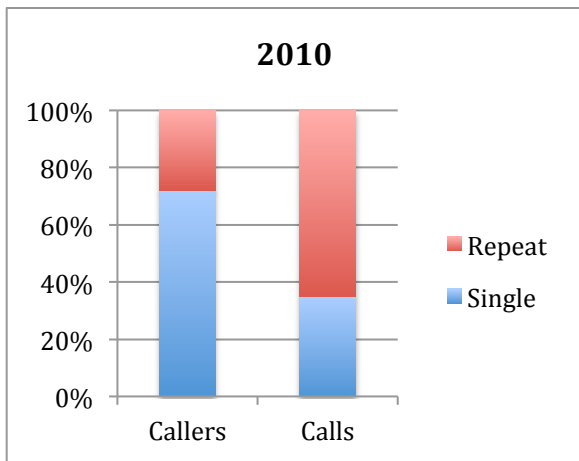
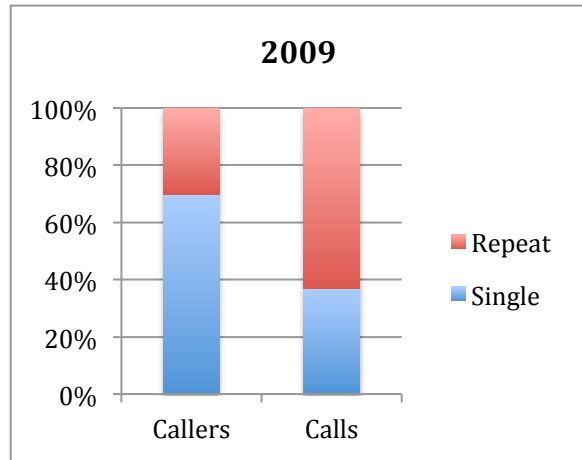
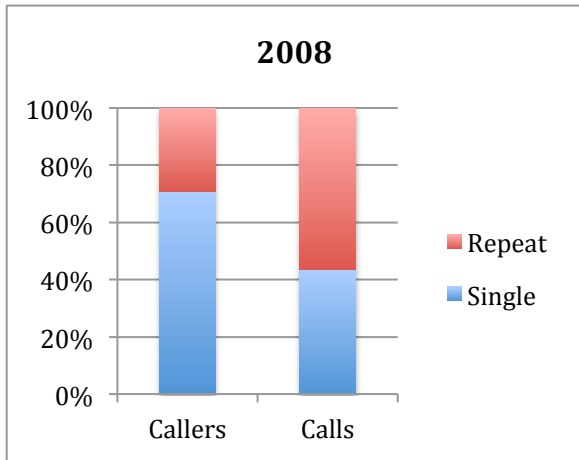
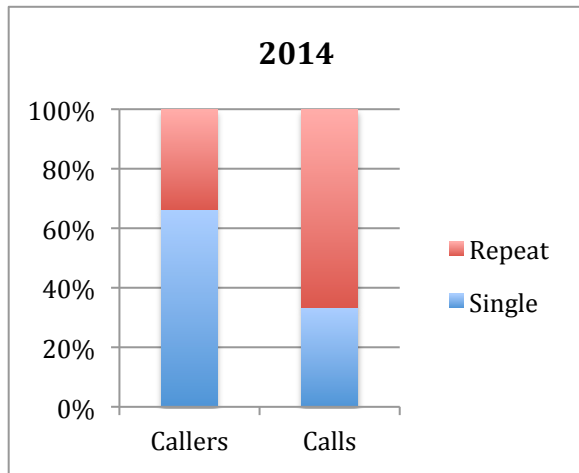


Figure 4 (continued). Percentage of calls made by one-time and repeat callers by year.



In addition to call and caller proportions, this study investigated the mean out-of-service time of lift assist calls during each year of this study period. Out-of-service time was recorded for each call in the study as part of the FireRMS entry. A summary of out-of-service time can be found in Table 3.

Table 3. Lift assist out-of-service times between 2006 – 2014.

	2006	2007	2008	2009	2010	2011	2012	2013	2014	Total
N	255	274	374	533	640	698	561	540	637	4512
Mean minutes per call (Std. Dev.)	18.02 (9.77)	17.25 (9.29)	16.88 (7.26)	17.47 (7.93)	17.46 (8.66)	18.04 (9.57)	18.33 (8.13)	18.70 (11.00)	18.16 (10.87)	17.88 (9.31)
25%	12.08	12.02	11.72	12.4	11.89	12.27	13.07	12.97	12.92	12.33
75%	21.45	19.88	19.6	20.53	20.9	21.1	21.1	21.44	20.8	20.74
Shortest call in minutes	6.4	5.78	5.78	5.45	4.83	3.73	4.08	4.27	6.00	3.73
Longest call in minutes	78.37	98.53	55.2	65.03	73.98	101.68	66.32	183.5	217.33	217.33
Total (hours)	76.57	78.66	105.23	155.20	186.26	209.83	171.40	168.31	192.82	1344.29

Mean out-of-service time did not fluctuate substantially over the study period. Out-of-service time was derived by calculating the difference between the call dispatch time and the time at which responders departed from a caller’s home at the conclusion of the call. Total out-of-service time for lift assist calls increased steadily between 2006 and 2011, likely due to the increased number of lift assist calls. Total out-of-service time decreased between 2012 and 2013, and then increased again for the last year of the study period.

The majority of lift assist calls and callers originated out of private residents, as opposed to nursing facilities. However, the proportion of calls originating from nursing homes varies throughout the duration of the study period. A summary of call location can be found in Table 4.

Table 4. Lift assist caller location between 2006 – 2014.

	2006	2007	2008	2009	2010	2011	2012	2013	2014
Number of callers from private homes	130	141	179	234	247	282	250	241	253
Number of callers from nursing homes	22	33	51	48	62	76	64	50	69
Total number of callers	152	174	230	282	309	358	314	291	322
Proportion of calls originating from nursing homes	0.145	0.190	0.222	0.170	0.201	0.212	0.203	0.172	0.214

## Discussion

### Data Analysis

Throughout the duration of the study period, these data demonstrated an initial increase in proportion of lift assist calls out of all EMS/Public Service calls followed by a stabilization in recent years. The percentage of lift assist calls varied considerably from year to year, with a large statistically significant increase from 2009 to 2010, followed by a small drop from 2011 to 2012. This analysis suggests that, after several years of increase, the percentage of lift assist calls may have stabilized in recent years. This trend may be the result of the increasing percentage of older adults in the SKF&R first-due; in Federal Way, alone, U.S. census data estimates a 4.4% total population increase from 87,792 in 2010 residents to 91,676 in 2014 (U.S. Census Bureau, 2014). However, 52.8% of the incoming population included residents aged 65 and over (U.S. Census Bureau, 2014). Auburn can attribute 24.1% of its 9.6% population increase from 2010 to 2014 to incoming residents aged 65 and over (U.S. Census Bureau, 2014). Des Moines, on the other hand, experienced a 3.4% population increase; however, the population of residents aged 65 and over decreased by 5% (U.S. Census Bureau, 2014). Despite this decrease of older residents in Des Moines, Federal Way and Auburn both experienced a boom of incoming older residents, which may have attributed to increasing percentages of lift assist calls.

The percentage of calls from repeat callers has generally increased over the study period. Repetitive 911 calls may be due to several reasons. Repeat calls may indicate the early onset of medical illness (Cone, Ahern, Lee, Baker, Murphy, & Bogucki, 2013). Patients may have found their initial 911 response to be convenient and comprehensive, thus feeling more open to requesting additional lift assists throughout the year regardless of the severity of their situation.

Although SKF&R does not want to deter residents from calling 911 during a true emergency, the department may have to consider methods of minimizing calls from high utilizers. 911 education, either provided in-person or via informational postcards or brochures mailed to residents, can remind residents of the characteristics of a true emergency requiring immediate emergency services. Verbal reminders from FF while on the call may also serve to deter patients from unnecessarily requesting emergency assistance for non-emergencies.

These data also show that the majority of lift assist callers call from private homes. Individuals living alone or with families may not have access to fall prevention or lift assist resources available in nursing homes. Nursing homes require at least one nurse on-staff 24-hours a day. These nurses may be able to provide an intervention after a patient's first lift assist call to prevent the need to call in the future. Furthermore, some nursing homes are equipped with lift assist devices to help patients sit or stand up. There is no indication that the proportion of lift assist callers living in private homes has increased or decreased throughout the study period.

Mean out-of-service time per lift assist call has not fluctuated throughout the study period, which suggests that FFs are not requiring more time to respond to lift assist calls. The annual total number of out-of-service hours, however, has increased over the study period; understandably, more lift assist calls will result in more out-of-service time. Total out-of-service time increased from 76.57 to 192.82 hours. SKF&R logged 1,344.29 hours for lift assist calls throughout the entire study period. Note that these out-of-service times reflect that of a single vehicle arriving on-scene. Each vehicle will have at least two FFs attending; as such, the number of FF hours attending to lift assist calls is at least twice that of the recorded out-of-service time.

## Study Limitations

This study's methods and analysis faced several limitations. Most notable was the nature of the department database. Over 120 FFs input call data independently into FireRMS throughout their shifts. Some FFs may complete database entries more thoroughly than others. Furthermore, the time it takes for a firefighter to complete data entry for a single call may be delayed as FFs prioritize incoming calls over data entry during their shifts. As such, this method of data entry may result in many opportunities to input incorrect information. Due to the high frequency of lift assist calls for certain patients over a short periods of time, firefighters may not input thorough data, such as a supplementary narrative, into FireRMS for each lift assist call. As such, although the frequency cannot be confirmed, it is very likely that SKF&R experiences even more lift assist calls than have been identified within the database. Additionally, since patient information fields were not completed for all calls, individual patients could not be accurately tracked throughout the duration of the study period.

Additionally, FireRMS does not have the capability of “flagging” repeat 911 users. This limitation means different shifts of FFs may not realize they are responding to the same lift assist caller for several weeks. Currently, this information must be retroactively determined. Furthermore, the data analysis in this study is applicable only to SKF&R. Each EMS system, including others located within King County, use different database and operational systems that follow different input requirements. Any conclusions deriving from this study may not necessarily apply to other EMS systems.

## Study Comparison

Although the final values of this study did not match the 2010 department study exactly, the conclusions of this study supported those of the earlier study: the proportion of lift assist

calls, as well as total out-of-service time, has increased over time. The 2010 department study reported more lift assist calls per year than this thesis study, likely because this study had stricter requirements for defining a call as a lift assist. For example, SKFR received many calls from wheelchair-bound patients trapped in soft surfaces, such as grass and mulch. This study did not classify these calls as lift assist calls as they only required a push; FFs did not risk a lift-associated back injury when responding to this type of call. Despite slight differences in defining lift assists, both studies observed parallel changes in the proportion of lift assists between years. Even beyond 2010, this study demonstrated that the proportion of lift assist calls has continued to increase, and any trends of decreasing proportion were not statistically significant. Additionally, this study supported the 2010 department study conclusion that the majority of lift assist calls came from private homes.

### **Implication of Findings**

The implications of the result of this study impacts primarily the delegation of future resources within the fire department, potential future research, and the possible development of interventions targeting the lift assist population. A large proportion of lift assist callers, particularly those requesting lift assists several times a year, may require additional attention and resources to begin decreasing their call frequency. SKF&R may require additional resources dedicated to responding to these increasing low-acuity calls.

Furthermore, if possible, SKF&R may consider pursuing discussions with nursing/assisted care living facilities to target lift assist calls in these types of facilities. Although nursing home lift assist calls make up the minority, they do present a single point of contact to affect lift assist frequency originating from the nursing home. Several nursing homes within the SKF&R first-due have policies prohibiting staff from lifting fallen patients to avoid liability for

injured nursing staff. Changing these policies may help alleviate the number of times SKF&R must dispatch responders to a nursing home to lift an otherwise uninjured patient. Furthermore, SKF&R and nursing home staff may be able to discuss options for acquiring lift assist devices for their facility to assist staff, as necessary.

Future research can explore the cause of the overutilization of emergency services (e.g., behavioral disorders), as well as determining appropriate interventions to minimize usage of 911 for lift assists. One-time callers do not present the opportunity for intervention if they do not request additional lift assists over time, but repeat lift assist callers may be open to an intervention to prevent subsequent emergency calls.

Although the proportion of lift assists has stabilized in recent years at SKF&R, it has increased over a nine-year study period. The majority of these lift assist calls originate out of private homes, and over half of these calls result from patients requesting multiple lift assists a year. These patients present an opportunity for intervention, possibly at their residence, before the frequency of lift assist calls grows out of control. SKF&R FFs will have to prioritize and adjust resources to respond to the increase in lift assist calls if this trend continues. Further research may be required to determine why this increase has occurred, however, SKF&R and its community has several options to help lift assist patients.

## Appendix

### Instructions for Computing Logistic Regression in STATA 13

To compute the logistic regression measuring the statistical significance in change of lift assist proportions over each year of the study period, a new table had to be created. This table treated lift assists as a binomial variable; recorded calls were a lift assist, detailed as value “1,” or not a lift assist, detailed as value “0.” Lift assist calls and non-lift assist calls were totaled for each year. These totals were then formatted into the following table:

Year	Call Total	Lift Assist = 1
2006	255	1
2006	11729	0
2007	274	1
2007	11459	0
2008	374	1
2008	12115	0
2009	534	1
2009	11292	0
2010	641	1
2010	11060	0
2011	698	1
2011	11208	0
2012	562	1
2012	11867	0
2013	540	1
2013	12281	0
2014	638	1
2014	13191	0

This table was then imported into Stata 13 and then run through with the following command (variable name indicated in parenthesis):

```
.logit (Lift Assist = 1) i.(year) [fw=(call total)]
```

This command generated the following output:

```
Logistic regression          Number of obs = 110718
                             LR chi2(8)    = 449.54
                             Prob > chi2    = 0.0000
Log likelihood = -18646.162   Pseudo R2    = 0.0119
```

---

Outcome	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]	
-----+						
year						
2	.0951535	.0879985	1.08	0.280	-.0773203	.2676273
3	.3506123	.0822385	4.26	0.000	.1894279	.5117967
4	.7771022	.0772531	10.06	0.000	.6256889	.9285155
5	.9804953	.0752151	13.04	0.000	.8330765	1.127914
6	1.052392	.0743553	14.15	0.000	.9066584	1.198126
7	.7785413	.0766189	10.16	0.000	.628371	.9287115
8	.7043166	.0770721	9.14	0.000	.5532581	.8553752
9	.7996044	.0751667	10.64	0.000	.6522803	.9469284
_cons	-3.828556	.0632995	-60.48	0.000	-3.952621	-3.704491
-----						

The coefficients indicate the change in odds of a call being a lift assist call between each year.

In order to interpret this output so that the statistical significance in change between consecutive years could be measured, the following pairwise comparison of adjusted prediction command was entered into Stata:

```
.margins i.year, pwcompare(effects)
```

This command generated the following output:

Pairwise comparisons of adjusted predictions

Model VCE : OIM

Expression : Pr(Outcome), predict()

	Delta-method	Unadjusted	Unadjusted			
	Contrast	Std. Err.	z	P> z	[95% Conf. Interval]	
-----+						
newvar6						
<b>2 vs 1  </b>	<b>.0020746</b>	<b>.0019188</b>	<b>1.08</b>	<b>0.280</b>	<b>-.0016861</b>	<b>.0058353</b>
3 vs 1	.008668	.0020159	4.30	0.000	.0047169	.012619
4 vs 1	.0238764	.0023203	10.29	0.000	.0193287	.028424
5 vs 1	.0335033	.0024826	13.50	0.000	.0286375	.038369
6 vs 1	.0373475	.0025245	14.79	0.000	.0323996	.0422955
7 vs 1	.0239385	.0022828	10.49	0.000	.0194642	.0284127
8 vs 1	.02084	.0022101	9.43	0.000	.0165083	.0251717
9 vs 1	.0248566	.0022181	11.21	0.000	.0205092	.029204
<b>3 vs 2  </b>	<b>.0065934</b>	<b>.0020664</b>	<b>3.19</b>	<b>0.001</b>	<b>.0025434</b>	<b>.0106434</b>
4 vs 2	.0218018	.0023643	9.22	0.000	.0171679	.0264357
5 vs 2	.0314287	.0025237	12.45	0.000	.0264823	.0363751

6 vs 2		.035273	.002565	13.75	0.000	.0302456	.0403003
7 vs 2		.0218639	.0023275	9.39	0.000	.017302	.0264258
8 vs 2		.0187655	.0022562	8.32	0.000	.0143433	.0231876
9 vs 2		.022782	.0022641	10.06	0.000	.0183445	.0272195
<b>4 vs 3</b>		<b>.0152084</b>	<b>.0024437</b>	<b>6.22</b>	<b>0.000</b>	<b>.0104188</b>	<b>.019998</b>
5 vs 3		.0248353	.0025983	9.56	0.000	.0197427	.0299279
6 vs 3		.0286796	.0026384	10.87	0.000	.0235083	.0338508
7 vs 3		.0152705	.0024082	6.34	0.000	.0105505	.0199905
8 vs 3		.012172	.0023394	5.20	0.000	.0075869	.0167572
9 vs 3		.0161886	.002347	6.90	0.000	.0115886	.0207885
<b>5 vs 4</b>		<b>.0096269</b>	<b>.002841</b>	<b>3.39</b>	<b>0.001</b>	<b>.0040587</b>	<b>.0151951</b>
6 vs 4		.0134712	.0028777	4.68	0.000	.0078309	.0191114
7 vs 4		.0000621	.0026682	0.02	0.981	-.0051675	.0052917
8 vs 4		-.0030363	.0026063	-1.17	0.244	-.0081445	.0020718
9 vs 4		.0009802	.0026131	0.38	0.708	-.0041413	.0061017
<b>6 vs 5</b>		<b>.0038443</b>	<b>.0030101</b>	<b>1.28</b>	<b>0.202</b>	<b>-.0020554</b>	<b>.0097439</b>
7 vs 5		-.0095648	.0028105	-3.40	0.001	-.0150733	-.0040564
8 vs 5		-.0126632	.0027517	-4.60	0.000	-.0180566	-.0072699
9 vs 5		-.0086467	.0027582	-3.13	0.002	-.0140526	-.0032408
<b>7 vs 6</b>		<b>-.0134091</b>	<b>.0028476</b>	<b>-4.71</b>	<b>0.000</b>	<b>-.0189903</b>	<b>-.0078279</b>
8 vs 6		-.0165075	.0027896	-5.92	0.000	-.0219751	-.0110399
9 vs 6		-.012491	.002796	-4.47	0.000	-.017971	-.0070109
<b>8 vs 7</b>		<b>-.0030984</b>	<b>.002573</b>	<b>-1.20</b>	<b>0.229</b>	<b>-.0081414</b>	<b>.0019445</b>
9 vs 7		.0009181	.0025799	0.36	0.722	-.0041383	.0059745
<b>9 vs 8</b>		<b>.0040165</b>	<b>.0025157</b>	<b>1.60</b>	<b>0.110</b>	<b>-.0009142</b>	<b>.0089473</b>

The pairwise comparisons between consecutive years have been bolded. P-values lower than 0.05 were considered to be statistically significant changes in proportion of lift assists between years.

### Documentation of Mathematical Equations used in Data Analysis

Table 1 consisted of calculating the percentage of lift assists out of total lift assists per year. This calculation was conducted as follows:

$$(\text{Total number of lift assists that year})/(\text{Total number of EMS/Public Service Calls}) * 100$$

This calculation was repeated for each year of the study period.

Table 2 consisted of calculating the percentage of single and repeat callers out of all lift assist callers per year. For each row, the listed value in each column acted as the numerator, while the total number of lift assist callers that year acted as the denominator. Each percentage was then calculated as follows:

$$(\text{Numerator})/(\text{Denominator}) * 100$$

Calculations in Table 3 included the mean out-of-service time per call per year, as well as the total number of out-of-service hours per year. First, total out-of-service time was summed per year in minutes. This sum was then divided by the total number calls that year to get the mean out-of-service time per year. Then, the total out-of-service time value was divided by 60 minutes/1 hour to convert the value to hours.

Table 4 shows the calculation of the proportion of lift assist calls originating out of nursing homes. This proportion was calculated by dividing the number of callers requesting a lift assist originating out of nursing homes by the total number of callers.

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